MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2021/2022

BQT1614 – QUANTITATIVE ANALYSIS

(All Sections/Groups)

22 NOVEMBER 2021
9.00 a.m.- 12.00 p.m.
(3 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of ELEVEN (11) pages (excluding the cover page).

2. Answer **ALL** questions. The marks distributions are given in parentheses.

3. The Formulae Sheet and the Statistical Tables are provided.

4. Please write all your answers in the answer booklets provided.

QUESTION 1

The Diabetes Association recommends a blood glucose reading of less than 130 for those with Type 2 diabetes. Blood glucose measures the amount of sugar in the blood. Below are the readings of people who were recently diagnosed with Type 2 diabetes:

112	122	116	103	97	96	115	98
106	124	116	98	116	108	112	112
95	116	107	118	123	109	99	106

a) Calculate the mean and median of the data.

(5 marks)

b) Find the standard deviation and coefficient of variation of the data.

(5 marks)

c) Calculate Pearson's Coefficient of Skewness. Describe the distribution of data.

(4 marks)

d) Find the 95% confidence interval for the proportion of a blood glucose reading of less than 100.

(6 marks)

(Total: 20 marks)

Continued…

QUESTION 2

a) Based on the past data, 8% of customers will order a dessert with the meal at a noodle's restaurant. 14% of them will order a bottled beverage.

i. What is the probability that a customer will order both a dessert and a bottled average?

(2 marks)

ii. The customers have ordered a dessert with the meal. Calculate the probability that he or she will order a bottled beverage.

(2 marks)

b) The Graduate Management Admission Test (GMAT) is a requirement for all applicants of MBA programs. A variety of preparatory courses are designed to help applicants improve their GMAT scores, which range from 200 to 800. Suppose that a survey of MBA students reveals that among GMAT scorers at least 650, 72% took a preparatory course; whereas among GMAT scores of less than 650 only 31% took a preparatory course. The probability for an applicant to score at least 650 is 30%. Suppose he was not taking the preparatory course. What is his probability of achieving 650 or more for GMAT score?

(5 marks)

c) Diane Bruns is the mayor of a large city. Lately, she has become concerned about the possibility that large numbers of people who are drawing unemployment checks are secretly employed. Her assistant estimates that 40 percent of unemployment beneficiaries fall into this category. She asks her assistant to conduct a quiet investigation of ten randomly selected unemployment beneficiaries.

i. What is the probability which at least eight of the individuals are secretly employed?

(3 marks)

ii. Find the mean and standard deviation of the individuals who are secretly employed.

(2 marks)

d) A company that sells annuities must base the annual pay-out on the probability distribution of the length of life of the participants in the plan. Suppose the probability distribution of the lifetimes of the participants follows a normal distribution with a mean of 68 years and a standard deviation of 3.5 years.

i. What is the probability of the plan recipients die before they reach the standard retirement age of 60?

(3 marks)

ii. Find the age at which payments have ceased for approximately 85% of the plan participants.

(3 marks)

(Total: 20 marks)

Continued…

QUESTION 3

a) Mr Oh believes that more than 90% of university students had made at least one purchase through online shopping applications. Out of a random sample of 150 university students, 140 students made at least one purchase through online shopping applications. Test at the 5% significance level to determine if more than 90% of the university students had made at least one purchase through online shopping applications.

(8 marks)

b) A group of lecturers would like to study XYZ university students' average Grade Point Average (GPA). The following information is obtained to achieve the aim

	Male	**Female**
Mean	3.1	3.3
Standard deviation	1.2	0.5
Sample size	20	20

At the 0.1 significance level and assume equal variances, test if there is a difference between the average GPA of male and female students.

(12 marks)
(Total: 20 marks)

Continued…

QUESTION 4

According to the research conducted by a group of MMU lecturers, students' Grade Point Average (GPA) can be explained by the number of credit hours. Therefore, to further investigate if there is a relationship between student's GPA and the number of credit hours, a random sample of 15 students is selected and their GPA and number of credit hours of Trimester 1, 2020/2021 are recorded in the following table:

GPA	Number of Credit Hours
4.0	12
3.5	15
3.8	12
3.3	18
3.0	20
3.5	16
3.6	17
2.9	20
3.0	18
3.4	15
3.1	20
2.8	20
3.3	18
3.4	18
3.6	16

a) Identify the independent variable and the dependent variable

(2 marks)

b) Compute the coefficient of correlation and interpret its value.

(4 marks)

c) Compute the coefficient of determination and interpret its value.

(2 marks)

d) Determine the equation of the regression line.

(6 marks)

e) Interpret the meaning of the slope.

(2 marks)

f) If a student is taking 16 credit hours, estimate the student GPA. Is the estimation reliable?

(4 marks)

(Total: 20 marks)

Continued…

QUESTION 5

a) Mr and Mrs Chong are considering two types of education saving for their children. Saving A requires Mr and Mrs Chong to deposit RM500 at the end of each month and it earns interest of 3% per year compounded monthly. Saving B requires Mr and Mrs Chong to deposit an initial sum of RM50,000 for ten years and it earns interest of 2.5% per year compounded quarterly. How long will it take for Saving A to accumulate the same amount as Saving B?

(6 marks)

b) How much should be deposited into a bank account paying interest at the rate of 4% per year compounded monthly so that at the end of 5 years it is equivalent to a saving plan with a monthly payment of RM300, which earns interest at the rate of 4.5% year compounded monthly?

(5 marks)

c) An investment earning interest at the rate of $r\%$ per year compounded quarterly grew from an initial sum of RM2000 to RM3000 in 3 years. What is the value of r?

(4 marks)

d) The prices and the numbers of various items used by a construction company are listed below:

Item	**2015**		**2020**	
	Price (RM)	Quantity	Price (RM)	Quantity
Cement	16	1700	18	2000
Brick	2	125,000	2.5	130,000
TMX Steel	4	400	5	430
Binding Wire	40	600	42	630

Compute the Fisher's Ideal Price Index for 2020 using 2015 as the base period.

(5 marks)

(Total: 20 marks)

Continued…

APPENDIXES:

I. STATISTICAL FORMULAE

A. DESCRIPTIVE STATISTICS

Sample mean: $\overline{X} = \dfrac{\sum x}{n}$

Sample standard deviation: $S = \sqrt{\dfrac{\sum x^2}{n-1} - \dfrac{(\sum x)^2}{n(n-1)}}$

Coefficient of variation (sample): $CV = \dfrac{S}{\overline{X}} \times 100\%$

Pearson coefficient of skewness: $S_K = \dfrac{3(\overline{X} - Median)}{S}$

B. PROBABILITY

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$P(A \cap B) = P(A) \times P(B)$ if A and B are independent

$P(A \mid B) = P(A \cap B) \div P(B)$

Poisson Probability Distribution

If X follows a Poisson Distribution P (λ) where $P(X = x) = \dfrac{e^{-\lambda}\lambda^x}{x!}$

then the mean = E(X) = λ and variance = VAR(X) = λ

Binomial Probability Distribution

If X follows a Binomial Distribution B(n, p) where $P(X = x) = {}^nC_x p^x q^{n-x}$

then the mean = E(X) = np and variance = VAR(X) = npq where q = 1- p

Normal Distribution

If X follows a Normal distribution N(μ , σ) where E(X) = μ and VAR(X) = σ^2

then $Z = \dfrac{X - \mu}{\sigma}$

C. CONFIDENCE INTERVAL ESTIMATION AND SAMPLE SIZE DETERMINATION

$(100-\alpha)\%$ Confidence Interval for Population Mean:

If σ known, μ: $\overline{x} \pm Z_{\alpha/2}\dfrac{\sigma}{\sqrt{n}}$

If σ unknown, μ: $\overline{x} \pm t_{\alpha/2,n-1}\dfrac{s}{\sqrt{n}}$

$(100-\alpha)\%$ Confidence Interval for Population Proportion, π: $p \pm Z_{\alpha/2}\sqrt{\dfrac{p(1-p)}{n}}$

Sample Size Determination for Population Mean: $n = \left(\dfrac{(Z_{\alpha/2})\ \sigma}{e}\right)^2$

Sample Size Determination for Population Proportion: $n = \dfrac{(Z_{\alpha/2})^2 \pi(1-\pi)}{e^2}$

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D. HYPOTHESIS TESTING

One Sample Mean Test

***Z*-test:** $Z = \dfrac{\bar{x} - \mu}{\dfrac{\sigma}{\sqrt{n}}}$ ***t*-test:** $t = \dfrac{\bar{x} - \mu}{\dfrac{s}{\sqrt{n}}}$

One Sample Proportion Test

$$Z = \frac{p - \pi}{\sqrt{\dfrac{\pi(1-\pi)}{n}}}$$

Two Sample Mean Test

***Z*-test**: $Z = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}}}$

***t*-test**: $t = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{s_p\sqrt{\left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)}}$ where $s_p = \sqrt{\dfrac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$

Two Sample Proportion Test

$$Z = \frac{(p_1 - p_2) - (\pi_1 - \pi_2)}{\sqrt{\bar{p}(1-\bar{p})\left[\dfrac{1}{n_1} + \dfrac{1}{n_2}\right]}} \quad \text{where} \quad \bar{p} = \frac{x_1 + x_2}{n_1 + n_2}; \quad p_1 = \frac{x_1}{n_1}; \quad p_2 = \frac{x_2}{n_2}$$

E. REGRESSION ANALYSIS

Simple Linear Regression

$y_i = b_0 + b_1 x_i$ where $b_0 = \bar{Y} - b_1\bar{X}$ and $b_1 = \dfrac{\sum XY - \left[\dfrac{\sum X \sum Y}{n}\right]}{\left[\sum X^2 - \left(\dfrac{(\sum X)^2}{n}\right)\right]}$

Correlation Coefficient

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

ANOVA Table for Regression

Source	Degrees of Freedom	Sum of Squares	Mean Squares
Regression	*1*	SSR	MSR = SSR/1
Error/Residual	*n – 2*	SSE	MSE = SSE/(*n – 2*)
Total	*n – 1*	SST	

Test Statistic for Significance of the Predictor Variable

$t_i = \dfrac{b_i}{S_{b_i}}$ and the critical value = $\pm t_{\alpha/2,(n-p-1)}$ where p = number of predictor

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F. INDEX NUMBERS

Simple Price Index $I = \frac{p_t}{p_0} \times 100$	**Simple Aggregate Price Index** $I_U = \frac{\sum p_t}{\sum p_0} \times 100$
Laspeyres Quantity Index $LQI = \frac{\sum p_0 q_t}{\sum p_0 q_0} \times 100$	**Paasche Quantity Index** $PQI = \frac{\sum p_t q_t}{\sum p_t q_0} \times 100$
Laspeyres Price Index $LPI = \frac{\sum p_t q_0}{\sum p_0 q_0} \times 100$	**Paasche Price Index** $PPI = \frac{\sum p_t q_t}{\sum p_0 q_t} \times 100$
Fisher's Ideal Price Index $\sqrt{(Laspeyres Price Index)(Paasche Price Index)}$	**Value Index** $V = \frac{\sum p_t q_t}{\sum p_0 q_0} \times 100$

G. FINANCIAL MATHEMATICS

Simple Interest

Interest: $I = \Pr t$

Accumulated amount: $A = P(1 + rt)$

Compounded Interest

Accumulated amount: $A = P(1 + i)^n$

Present Value: $P = A(1 + i)^{-n}$

Interest: $I = P(1 + i)^n - P$

Effective rate of interest

$r_e = \left(1 + \frac{r}{m}\right)^m - 1$

Sinking Fund $R = \left[\frac{Si}{(1+i)^n - 1}\right]$	**Amortization** $R = \left[\frac{Pi}{1-(1+i)^{-n}}\right]$
Future Value of an Annuity $A = R\left[\frac{(1+i)^n - 1}{i}\right]$	**Present Value of an Annuity** $P = R\left[\frac{1-(1+i)^{-n}}{i}\right]$

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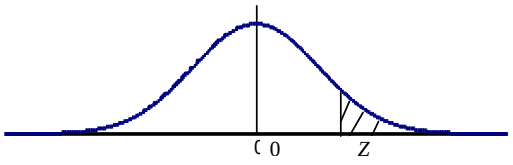
II. STATISTICAL TABLE

Table 1

The Upper Tail Area Under the Standard Normal Curve



Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
3.5	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
3.6	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.7	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.8	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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TABLE 10. PERCENTAGE POINTS OF THE t-DISTRIBUTION

This table gives percentage points $t_\nu(P)$ defined by the equation

$$\frac{P}{100} = \frac{1}{\sqrt{\nu\pi}} \frac{\Gamma(\frac{1}{2}\nu + \frac{1}{2})}{\Gamma(\frac{1}{2}\nu)} \int_{t_\nu(P)}^{\infty} \frac{dt}{(1 + t^2/\nu)^{\frac{1}{2}(\nu+1)}}.$$

Let X_1 and X_2 be independent random variables having a normal distribution with zero mean and unit variance and a χ^2-distribution with ν degrees of freedom respectively; then $t = X_1/\sqrt{X_2/\nu}$ has Student's t-distribution with ν degrees of freedom, and the probability that $t \geqslant t_\nu(P)$ is $P/100$. The lower percentage points are given by symmetry as $-t_\nu(P)$, and the probability that $|t| \geqslant t_\nu(P)$ is $2P/100$.

The limiting distribution of t as ν tends to infinity is the normal distribution with zero mean and unit variance. When ν is large interpolation in ν should be harmonic.

P	40	30	25	20	15	10	5	2·5	1	0·5	0·1	0·05
$\nu = 1$	0·3249	0·7265	1·0000	1·3764	1·963	3·078	6·314	12·71	31·82	63·66	318·3	636·6
2	0·2887	0·6172	0·8165	1·0607	1·386	1·886	2·920	4·303	6·965	9·925	22·33	31·60
3	0·2767	0·5844	0·7649	0·9785	1·250	1·638	2·353	3·182	4·541	5·841	10·21	12·92
4	0·2707	0·5686	0·7407	0·9410	1·190	1·533	2·132	2·776	3·747	4·604	7·173	8·610
5	0·2672	0·5594	0·7267	0·9195	1·156	1·476	2·015	2·571	3·365	4·032	5·893	6·869
6	0·2648	0·5534	0·7176	0·9057	1·134	1·440	1·943	2·447	3·143	3·707	5·208	5·959
7	0·2632	0·5491	0·7111	0·8960	1·119	1·415	1·895	2·365	2·998	3·499	4·785	5·408
8	0·2619	0·5459	0·7064	0·8889	1·108	1·397	1·860	2·306	2·896	3·355	4·50	5·041
9	0·2610	0·5435	0·7027	0·8834	1·100	1·383	1·833	2·262	2·821	3·250	4·29	4·781
10	0·2602	0·5415	0·6998	0·8791	1·093	1·372	1·812	2·228	2·764	3·169	4·144	4·587
11	0·2596	0·5399	0·6974	0·8755	1·088	1·363	1·796	2·201	2·718	3·106	4·025	4·437
12	0·2590	0·5386	0·6955	0·8726	1·083	1·356	1·782	2·179	2·681	3·055	3·930	4·318
13	0·2586	0·5375	0·6938	0·8702	1·079	1·350	1·771	2·160	2·650	3·012	3·852	4·221
14	0·2582	0·5366	0·6924	0·8681	1·076	1·345	1·761	2·145	2·624	2·977	3·787	4·140
15	0·2579	0·5357	0·6912	0·8662	1·074	1·341	1·753	2·131	2·602	2·947	3·733	4·073
16	0·2576	0·5350	0·6901	0·8647	1·071	1·337	1·746	2·120	2·583	2·921	3·686	4·015
17	0·2573	0·5344	0·6892	0·8633	1·069	1·333	1·740	2·110	2·567	2·898	3·646	3·965
18	0·2571	0·5338	0·6884	0·8620	1·067	1·330	1·734	2·101	2·552	2·878	3·610	3·922
19	0·2569	0·5333	0·6876	0·8610	1·066	1·328	1·729	2·093	2·539	2·861	3·579	3·883
20	0·2567	0·5329	0·6870	0·8600	1·064	1·325	1·725	2·086	2·528	2·845	3·552	3·850
21	0·2566	0·5325	0·6864	0·8591	1·063	1·323	1·721	2·080	2·518	2·831	3·527	3·819
22	0·2564	0·5321	0·6858	0·8583	1·061	1·321	1·717	2·074	2·508	2·819	3·505	3·792
23	0·2563	0·5317	0·6853	0·8575	1·060	1·319	1·714	2·069	2·500	2·807	3·485	3·768
24	0·2562	0·5314	0·6848	0·8569	1·059	1·318	1·711	2·064	2·492	2·797	3·467	3·745
25	0·2561	0·5312	0·6844	0·8562	1·058	1·316	1·708	2·060	2·485	2·787	3·450	3·725
26	0·2560	0·5309	0·6840	0·8557	1·058	1·315	1·706	2·056	2·479	2·779	3·435	3·707
27	0·2559	0·5306	0·6837	0·8551	1·057	1·314	1·703	2·052	2·473	2·771	3·421	3·690
28	0·2558	0·5304	0·6834	0·8546	1·056	1·313	1·701	2·048	2·467	2·763	3·408	3·674
29	0·2557	0·5302	0·6830	0·8542	1·055	1·311	1·699	2·045	2·462	2·756	3·396	3·659
30	0·2556	0·5300	0·6828	0·8538	1·055	1·310	1·697	2·042	2·457	2·750	3·385	3·646
32	0·2555	0·5297	0·6822	0·8530	1·054	1·309	1·694	2·037	2·449	2·738	3·365	3·622
34	0·2553	0·5294	0·6818	0·8523	1·052	1·307	1·691	2·032	2·441	2·728	3·348	3·601
36	0·2552	0·5291	0·6814	0·8517	1·052	1·306	1·688	2·028	2·434	2·719	3·333	3·582
38	0·2551	0·5288	0·6810	0·8512	1·051	1·304	1·686	2·024	2·429	2·712	3·319	3·566
40	0·2550	0·5286	0·6807	0·8507	1·050	1·303	1·684	2·021	2·423	2·704	3·307	3·551
50	0·2547	0·5278	0·6794	0·8489	1·047	1·299	1·676	2·009	2·403	2·678	3·261	3·496
60	0·2545	0·5272	0·6786	0·8477	1·045	1·296	1·671	2·000	2·390	2·660	3·232	3·460
120	0·2539	0·5258	0·6765	0·8446	1·041	1·289	1·658	1·980	2·358	2·617	3·160	3·373
∞	0·2533	0·5244	0·6745	0·8416	1·036	1·282	1·645	1·960	2·326	2·576	3·090	3·291

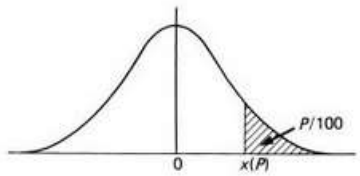
Continued…

TABLE 5. PERCENTAGE POINTS OF THE NORMAL DISTRIBUTION

This table gives percentage points $x(P)$ defined by the equation

$$\frac{P}{100} = \frac{1}{\sqrt{2\pi}} \int_{x(P)}^{\infty} e^{-\frac{1}{2}t^2}\, dt.$$

If X is a variable, normally distributed with zero mean and unit variance, $P/100$ is the probability that $X \geq x(P)$. The lower P per cent points are given by symmetry as $-x(P)$, and the probability that $|X| \geq x(P)$ is $2P/100$.



P	$x(P)$	P	$x(P)$	P	$x(P)$	P	$x(P)$	P	$x(P)$	P	$x(P)$
50	0·0000	5·0	1·6449	3·0	1·8808	2·0	2·0537	1·0	2·3263	0·10	3·0902
45	0·1257	4·8	1·6646	2·9	1·8957	1·9	2·0749	0·9	2·3656	0·09	3·1214
40	0·2533	4·6	1·6849	2·8	1·9110	1·8	2·0969	0·8	2·4089	0·08	3·1559
35	0·3853	4·4	1·7060	2·7	1·9268	1·7	2·1201	0·7	2·4573	0·07	3·1947
30	0·5244	4·2	1·7279	2·6	1·9431	1·6	2·1444	0·6	2·5121	0·06	3·2389
25	0·6745	4·0	1·7507	2·5	1·9600	1·5	2·1701	0·5	2·5758	0·05	3·2905
20	0·8416	3·8	1·7744	2·4	1·9774	1·4	2·1973	0·4	2·6521	0·01	3·7190
15	1·0364	3·6	1·7991	2·3	1·9954	1·3	2·2262	0·3	2·7478	0·005	3·8906
10	1·2816	3·4	1·8250	2·2	2·0141	1·2	2·2571	0·2	2·8782	0·001	4·2649
5	1·6449	3·2	1·8522	2·1	2·0335	1·1	2·2904	0·1	3·0902	0·0005	4·4172

End of Paper